THURSDAY, JUNE 20, 1912.

INTRODUCTIONS TO BIOLOGY.

(1) *Outlines of Evolutionary Biology.* By Prof. Arthur Dendy, F.R.S. Pp. xiv+454. (London: Constable and Co., Ltd., 1912.) Price 12*s*. 6*d*. net.

(2) *Lebensweise und Organisation: Eine Einführung in die Biologie der wirbellosen Tiere.* By Prof. P. Deegener. Pp. x+288. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 5 marks.

(3) *Einführung in die Biologie.* By Prof. Otto Maas and Dr. Otto Renner. Pp. ix+394. (München and Berlin: R. Oldenbourg, 1912.) Price 8 marks.

(4) *The Life of the Plant.* By Prof. C. A. Timiriazeff. Translated from the revised and corrected Seventh Russian Edition by Miss Anna Chérémételf. Pp. xvi+355. (London: Longmans, Green and Co., 1912.) Price 7*s*. 6*d*. net.

(1) PROF. DENDY regrets that so little encouragement is given in this country to the study of biology in the strict sense—the study of the general principles underlying the special sciences of botany, zoology, protistology, and the like. We fear that there is too much truth in this, for while there may be a considerable leaven of general ideas in the course the medical student gets, whether it be a little botany and a little zoology, or the conjoint "bean and dogfish" scheme, it must be confessed that he has little opportunity for "a philosophical treatment of the subject." It is customary to say that he is not at the age and stage to appreciate it, but this is probably in the main an erroneous assumption, and we welcome Prof. Dendy's book because it supplies an effective introduction to biological conceptions without adding greatly to the burden of facts which the student is expected to bear about with him for a season. In reality, of course, it gives the burden a balance, which lightens it.

But besides medical students there is another constituency—and a rapidly increasing one—of men and women who wish to think biologically, because they have already learned to think clearly. They wish in particular to understand the bearing of biological conclusions upon human problems, and they are aware that the only way to get a grip of general principles is to submit to discipline in the concrete. Regular laboratory work is out of the question, and many remain platitudinarian. But, as Prof. Dendy points out, "We are apt to forget that in reality we all of us spend our lives in a biological laboratory, where we are surrounded by living organisms which we can hardly avoid studying. In this way we learn much of the nature of living things, and are to some extent prepared for the study of biological principles." To serious students who wish to understand the biological laboratory in which they live, Prof. Dendy's book will be a trustworthy and stimulating guide. We wish that he had been able to do even more in the way of indicating the biological significance of our familiar animate environment, but we cannot suggest what might be omitted to make room for this.

The first part of the book deals with the essential functions of the living body, the unicellular grade of organisation, the transition to the multicellular grade, the meaning of differentiation, and the cell theory. The second part deals with the evolution of sex and with reproduction, the third with variation and heredity, the fourth with the theory and evidences of organic evolution and with adaptations in plants and animals. The fifth part discusses the factors of organic evolution. It is all admirable; indeed, we do not know how it could be done better. It is packed with interesting material, old and new; the style is clear and vivid, yet the reader is continually being pulled up to think; there is a pleasant absence of dogmatism in regard to debated questions; there are numerous effective illustrations, many of which are new. The good qualities of the book stand out prominently in the chapter on the inheritance of acquired characters, in which the author admits the difficulty of saying yea or nay, warns the student against dogmatism, sets a good example of unbiassed examination of the evidence, concludes that "characters which are due to the continued action of some external stimulus, extending perhaps over many generations, in the long run become so firmly impressed upon the organism that they affect the germ-cells as well as the somatic cells, and thus become truly blastogenic," and then suggests an hypothesis—not perhaps to be pressed just now—that modifications of somatic cells may, by altering the character of the vibrations in the determinants of their own nuclei, affect the corresponding determinants in the distant germ-cells in a similar manner, in some way analogous to wireless telegraphy.

(2) The aim of Prof. Deegener's book is also to introduce the serious student to biological conceptions; the method is to take a survey of the invertebrates, using the diverse types in illustration of particular points. Thus the author uses the myonemes of Stentor and the like to illustrate division of labour within the cell, Volvox to throw light on the beginning of sexual reproduction, Hydra as a peg for a discussion of regeneration, the Trematodes as instances of adaptation to para-

sitic life, and so on. In a few lines often, with the aid of clear figures, he makes his point; thus the Echinococcus tapeworm is very small and with few joints, therefore relatively less prolific than usual, therefore (an indirect "therefore," of course) the bladder-worm stage has taken on a prolific multiplying function, which is most unusual. The studies of earthworm and pond-mussel are admirable, the familiar facts being used to illustrate general ideas. In the chapter on Crustaceans there is naturally a discussion of "moulting," of transformations of appendages, of special adaptations as in Leptodora, of larval stages, and so forth; while in the final chapter, which deals with insects, the author is very happy in his illustration of the adaptation of structure to particular conditions of life, which is, indeed, the general theme of the whole book. Prof. Deegener says in his preface that he has no wish to pander to easy-going readers who wish to be amused, but none the less his book is as interesting as it is instructive. The illustrations are mostly good; we wish, however, to direct attention to the fact that a number of well-known figures are referred, not to their original sources, but simply to the text-book from which they have been directly taken. This common practice seems to us to be very undesirable.

(3) Dr. Renner and Prof. Maas supply the botanical and the zoological parts respectively of an introduction to biology, primarily designed for teachers in the "Mittelschule." In some respects it may be put alongside of the late Prof. T. J. Parker's well-known "Elementary Biology"—a book which it would be hard to beat—but there are interesting differences in plan and method. The botanical half starts off with the parts of the plant, working down to the cell; then follow chapters on the structure and life of Thallophytes, Mosses and Ferns, and Flowering Plants; another section deals with nutrition in green plants and in saprophytes; the remaining chapters discuss inter-relations, habitats, power of movement, and the relations between plants and their environment. The book is full of interesting material, which is clearly and tersely dealt with; and the text is illustrated by a large number of original figures, which it is a relief to see. Dr. Maas begins again with the animal cell and goes on to the Protozoa. From animal organisation at the single cell level he proceeds to the "tissue-level" in Cœlentera, and to the "organ-level" in worms. After a condensed chapter on classification and the evidences of evolution, the book takes a different turn, dealing with the various systems, nutritive, respiratory, vascular, excretory, muscular, nervous, and sensory. It culminates in short chapters discussing development, regeneration, fertilisation, heredity, and the factors of evolution. As one would expect from Prof. Maas, this zoological introduction to biology is a sound piece of work, clear and up-to-date, but it will surely require a good deal of boiling down before being naturally suitable for the erudite youths of the "Mittelschule." It appears to us that more "natural history," and less analytical biology, would have been more appropriate, but this, of course, was not what Dr. Maas intended to supply. Most of the illustrations are good and many of them fresh.

(4) Prof. Timiriazeff's "Life of the Plant" was delivered as a course of lectures in Moscow in 1876, and has passed through seven Russian editions. Its aim was to make the life of the plant intelligible to a popular audience, and the author expressed in his preface to the first Russian edition his sense of the difficulty of his undertaking. In a popular exposition it is impossible to tell the whole truth, and with a young science like plant physiology it is difficult to tell nothing but the truth. Moreover, in popular exposition, the expert must step back a little from his science to see what it looks like at a distance. Prof. Timiriazeff thinks that his book "not only in its general tendency, but even in the choice of matter and in the order of exposition," may "answer the present requirements of English schools as formulated by so eminent an authority as Prof. Armstrong."

When a master of a craft condescends to write popularly, we look out for something "big," and there is no doubt that Timiriazeff's book stands head and shoulders above most of its fellows. It has a wide sweep, beginning with the analysis of flour and culminating in the Darwinian theory; it is very objective in its treatment; it skilfully utilises the familiar, and works Socratically; it is demonstrative rather than informative, giving the reader the delicious illusion that he is himself at work building up the science of plant physiology; it has a masterly simplicity of style to which the translator has surely done justice. The book will be of great service to teachers, in showing, for instance, what a lot can be made of relatively simple experiments; in showing, too, how a certain restraint and severity in the process of intellectual construction leads in the end to a very vivid picture of the living plant. It is after the patient course of induction that we come to perceive, in the depths of numberless cells, "protoplasm in ceaseless motion like the tide of the sea"; "the root buried deep in the ground, imbibing its liquid food and corroding the particles of the soil all along its course of many miles"; "the insignificant chlorophyll granules, wherein takes place the wondrous process of the transformation of the sun's rays into chemical energy, source of all the manifestations of life on our planet"; the flowers in illustration of "the wonderful ties which bind together the two kingdoms of Nature" and the forest as the sublimest picture of struggle and elimination and survival. In one respect we confess our disappointment that Prof. Timiriazeff should have seen fit to lend the weight of his authority to the side of the mechanistic biologists, and should have thought it necessary to refer to "Neovitalism" as a "morbid outgrowth."

MODERN MATHEMATICS FOR TEACHERS.

Monographs on Topics of Modern Mathematics Relevant to the Elementary Field. Edited by J. W. A. Young. Pp. viii+416. (London: Longmans, Green and Co., 1911.) Price 10*s*. 6*d*. net.

RECENT work on the first principles of mathematics has been so far-reaching and revolutionary that most, if not all, of those acquainted with the results are anxious to bring them to bear upon general education. For this there are two main reasons: in the first case, it cannot be right to go on pretending to teach a subject in a strictly logical way when all sorts of assumptions, many of them wrong, are being tacitly made; and secondly (this is still more important), the philosophical side of the new theories is bound, sooner or later, to have a profound effect upon educated thought. It is, for instance, a great achievement that mathematicians have now got definite concepts of three distinct "infinite numbers," as contrasted with the vague "∞" of former times; that they have proved the possibility of three distinct geometries, in two of which the axiom of parallels does not hold good; and that there is some prospect of bringing the theories of electricity and gravitation under one comprehensive hypothesis—it may be by a restatement of the laws of motion, or even by the assumption of a sort of four-dimensional space.

The trouble is that the treatises which deal with these matters scientifically are full of strange symbols and elaborate detail, so that it is hopeless to expect an average mathematical teacher to study them. Prof. Young and his colleagues have therefore done a real service by providing for secondary-school teachers chapters on nine important topics, partly but not wholly demonstrative, and mainly designed to give them a reasonably sufficient account of what has been done, so that in the light of their new knowledge they may modify their teaching.

The most important chapters are undoubtedly i.–iii., which treat of the foundations of geometry, modern pure geometry, and non-Euclidean geometry. They ought to make plain the character of a complete system of axioms and postulates, the notions of order, congruence, segment, and so on; the principles of duality and projectivity, and the properties of the elementary figures; and finally the justification of introducing the two non-Euclidean geometries. The treatment of the last-named is (quite rightly, we think) in great measure analytical ; the fact is that our false intuition of space is so ingrained that few of us will give it up until we are faced by a consistent set of fundamental formulæ.

Chapter iv., on the foundations of algebra, is perhaps the most rigorous of the nine. A set of twenty-seven postulates is drawn up, suited for ordinary complex algebra, and it is shown that they are sufficient, consistent, and independent. An appendix contains a note on Dedekind's theory of cuts and Cantor's method of sequences. What seems to us a defect in this chapter is that it assumes ordinary complex algebra as the most comprehensive one, and this is remarkable as coming from a compatriot of the Peirces. Surely in a chapter on general algebra some reference should have been given to quaternions, and to those systems where $ab=0$ does *not* require that either a or b should be 0. And we do not agree without reservation to the remark on p. 200, "both the arithmetical and the geometrical systems are equally entitled to stand as representatives of the type of algebra in question." To justify this, we must at least assume the Dedekind-Cantor postulate.

Chapter vi., on the function-concept and elementary notions of the calculus, does not go very far, and may, perhaps, be taken to give more value to the "graph" than it really does; but it is lucid and interesting, and, at any rate, gives Dirichlet's definition of a one-valued function, and refers to Weierstrass's proof that a continuous function need not have a differential coefficient. Curiously enough, in dealing with maxima and minima the author omits to notice the case when dy/dx is infinite, and does not bring out the real point that dy/dx must change sign. There is some rather vague talk about different ranges of the independent variable; for analytical purposes the range must be some definite one-dimensional arithmetical field, and clearness would be gained by saying that, for strict differentiation, it must be a segment of the arithmetical continuum. For instance, let $f(x)=1$ when x is rational, and $f(x)=0$ when x is not: this is a definite one-valued function, and if the field of x is the field of